Decision Rationale

Total Maximum Daily Load for
The Aquatic Life Use Impairment on
The Roanoke River Botetourt, Floyd, Montgomery and Salem Counties Virginia

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by a state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety (MOS), that may be discharged to a water-quality limited water body.

This document will set forth the U. S. Environmental Protection Agency's (EPA) rationale for approving the TMDL for the aquatic life use impairment on the Roanoke River. EPA's rationale is based on the determination that the TMDL meets the following eight regulatory conditions pursuant to 40 CFR §130.

1) The TMDL is designed to implement applicable water quality standards.
2) The TMDL includes a total allowable load as well as individual waste load allocations (WLAs) and load allocations (LAs).
3) The TMDL considers the impacts of background pollutant contributions.
4) The TMDL considers critical environmental conditions.
5) The TMDL considers seasonal environmental variations.
6) The TMDL includes a MOS.
7) There is reasonable assurance that the TMDL can be met.
8) The TMDL has been subject to public participation.

II. Background

The Roanoke River Watershed runs through Botetourt, Floyd, Montgomery, Roanoke and Salem Counties, Virginia. The Roanoke River is a large river which discharges directly to Albemarle Sound. The benthic impairment on the Roanoke River begins approximately 205 miles upstream of its mouth at its confluence with Mason Creek and terminates at the Niagara Dam. The 335,000-acre watershed is rural with forested and agricultural land making up 87 percent of the watershed. Most of the remaining watershed is composed of developed land.

In response to Section 303(d) of the CWA, the Virginia Department of Environmental Quality listed the Roanoke River (VAW-L04R) on Virginia's 1996 Section 303(d) list as being unable to attain the general standard due to an aquatic life use impairment identified through benthic assessments. The river was also listed for bacteria and polychlorinated biphenyls impairments. This decision rationale will address the TMDL for the aquatic life use

impairments.

To assess the biological integrity of a stream, Virginia uses EPA's Rapid Bioassessment Protocol II (RBPII) to determine the status of a stream's benthic macroinvertebrate community.[1] This approach evaluates the benthic macroinvertebrate community between a monitoring site and its reference station. Measurements of the benthic community, called metrics, are used to identify differences between monitored and reference stations.[2] The state is currently in the process of changing this methodology to a stream condition index (SCI) approach.

As part of the RBPII approach, reference stations are established on streams which are minimally impacted by humans and have a healthy benthic community. These reference stations represent the desired community for the monitored sites. Monitored sites are evaluated as non-impaired, slightly impaired, moderately impaired, or severely impaired based on a comparison of the biological community of the reference and monitored sites. Streams that are classified as moderately (after a confirmatory assessment) or severely impaired after an RBPII evaluation are classified as impaired and are placed on the Section 303(d) list of impaired waters. Monitoring stations at river miles 202, 205 and 206 have been consistently assessed as moderately impaired. The monitoring station at river mile 212 has historically been assessed as slightly impaired and was not listed on the Section 303(d) list. A bioassessment station at river mile 224 was used as the reference station for this water as it was found to be unimpaired. Similar assessment results were found when the SCI was used as the assessment methodology.

The RBPII analysis assesses the health of the macroinvertebrate community of a stream. The analysis will inform the biologist if the stream's benthic community is impaired. However, it will not inform the biologist as to what is necessarily causing the degradation of the benthic community. Additional analysis may be required to determine the pollutants which are causing the impairment as information can be gleaned based on the composition of the community and the condition of the habitat. TMDL development requires the identification of impairment causes and the establishment of numeric endpoints that will allow for the attainment of designated uses and water quality criteria.[3]

It was necessary to determine what stressor was causing this impairment in the watershed and at what concentrations this stressor could be assimilated by the Roanoke River without negatively impacting its biological community. All possible stressors were evaluated against Virginia's applicable numeric water quality criteria, guidance thresholds or other applicable criteria. Based on this comparison, pollutants were determined to be a non-stressor, possible

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[1]Tetra Tech 2002. Total Maximum Daily Load (TMDL) Development for Blacks Run and Cooks Creek. Fairfax, Virginia.

[2]Ibid 1

[3]Ibid 1

stressor or most probable stressor. Sediment was determined to be the most probable stressor. However, a numeric water quality criterion does not exist for sediment. Therefore, a reference watershed approach was used to determine the numeric endpoint for the sediment load to the Roanoke River. Numeric endpoints represent the water quality goals that are to be achieved through the implementation of the aquatic life use TMDL which will allow the impaired water to attain its designated use. A reference watershed approach is based on selecting a non-impaired watershed that shares similar land use, ecoregion, and geomorphological characteristics with the impaired watershed. The stream conditions and loadings in the reference stream are assumed to be the conditions needed for the impaired stream to attain standards. An upstream portion of the Roanoke River, around river mile 224, was used as the reference watershed for the Roanoke River.

The benthic TMDL was developed using the Generalized Watershed Loading Function model (GWLF). The GWLF model has the ability to simulate runoff, sediment, and nutrient loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land).[4] GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[5] Calculations are made for sediment based on daily water balance totals that are summed to give monthly values.

Table 1 - Summarizes the Specific Elements of the TMDL.

Segment	Parameter	TMDL	WLA	LA	MOS
Roanoke River	Sediment (Tons/yr)	21,079	5,189	13,782	2,108

The United States Fish and Wildlife Service has been provided with copy of the TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the eight basic requirements for establishing an aquatic life (benthic) use impairment TMDL for the Roanoke River. EPA is therefore approving the TMDL. EPA's approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

As stated above, the biological assessments on Roanoke River were not able to discern a clear stressor to the Roanoke. The TMDL modelers therefore conducted a stressor identification analysis to determine what was impacting the benthic community. Ambient water quality data

[4]Ibid 1

[5]Ibid 1

was able to rule out dissolved oxygen, temperature or pH as possible stressors to the Roanoke River. An excessive loading of sediment was seen as the cause of the benthic impairment on Roanoke River. This determination was based on the results of several habitat assessments. In high enough concentrations, sediment can have detrimental impacts on the benthic community. Sediment fills interstitial spaces that provide habitat for many organisms. Excessive levels of sediment may also clog an organisms gill surfaces thus lowering its respiratory ability. Lastly, excessive sediment increases turbidity which lowers the feeding efficiency of visual predators. Toxicity testing on fathead minnows and water fleas revealed that toxicity may be an issue as well. The toxicity sampling was conducted immediately after a storm and this first flush of storm water sediment was believed to be the cause of toxicity. Therefore, the TMDL recommended that additional sampling be conducted to further evaluate this possible stressor. Lowering the sediment loading to the Roanoke River may also lessen the toxicity impacts since the pollutant causing the toxicity can be adsorbed to the sediment particles.

The GWLF model was used to determine the loading rates of sediment to the impaired and reference waters from all point and nonpoint sources. The TMDL modelers determined the sediment loading rates within each watershed. Data used in the model was obtained on a wide array of items, including land uses in the area, point sources in the watershed, weather, stream geometry, etc.

The GWLF model provides the ability to simulate runoff and sediment loadings from watersheds given variable source areas (e.g., agricultural, forested, and developed land). GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations.[6] Local rainfall and temperature data were needed to simulate the hydrology; this data was obtained from the National Climatic Data Center station at Roanoke International Airport. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of vegetation, land slope, soil erodibility and land practices used in the area.[7] Parameters within the model account for these conditions and practices. A stream channel erosion model was added to GWLF to account for this source of sediment. The GWLF model was developed to simulate hydrology in ungaged watershed. However, to ensure that the hydrology was accurately simulating the system the model was calibrated to United States Geological Survey gage 2055000 on the Roanoke River.

The appropriate sediment loading to the impaired segment of the Roanoke River was determined based on the simulated sediment load to the reference watershed, the upper Roanoke. Since the upper Roanoke River is a non-impaired watershed similar in characteristics to the

[6]Ibid 1

[7]Ibid 1

impaired segment, it is assumed that the sediment loading to this segment of the Roanoke River would allow the impaired segment of the Roanoke River to contain a non-impaired benthic community.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading is the sum of the loads allocated to land- based precipitation-driven nonpoint source areas (forest and agricultural land segments) and point sources. Activities that increase the levels of sediment to the land surface or their availability to runoff are considered flux sources. The actual value for total loading can be found in Table 1 of this document. The total allowable load is calculated on an annual basis.

Waste Load Allocations

There are several facilities actively discharging sediment to the impaired segment of the Roanoke River at this time. There are individually permitted facilities which are identified in Table 2 and whose WLA was determined by multiplying their annual flow by their allowable concentration of sediment. There were also several authorities with municipal separate storm sewer systems (MS-4) permits in the watershed. These jurisdictions discharge sediment to the river through their MS-4s. The MS-4 loads are also provided in Table 2. There were also general permits issued for domestic sewage, mines, construction sites and industrial stormwater. The WLAs associated with these sources can be found in Appendix D of the report. The WLAs for individual industrial stormwater permits can be found in Appendix D as well.

EPA regulations require that an approvable TMDL include individual WLAs for each point source. According to 40 CFR 122.44(d)(1)(vii)(B), "Effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, are consistent with assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA pursuant to 40 CFR 130.7." Furthermore, EPA has authority to object to the issuance of any National Pollutant Discharge Elimination System (NPDES) permit that is inconsistent with the WLAs established for that point source.

Table 2 – WLAs for Sediment for the Roanoke River

Facility Name	Type of Permit	Permit Number	Annual Load (Tons/Yr)
Western Virginia Water Authority	Individual	VA0025020	472.2
Roanoke Electric Steel Corp.	Individual	VA0001589	92.9
Shawville Town STP	Individual	VA0024031	9.1
Carvin Cove Water Filtration Plant	Individual	VA0001473	17.6
Crystal Springs WTP	Individual	VA0091065	8.8
Norfolk Southern Railway Corp. –	Individual	VA0001597	1.62

Shaffers Crossings			
Ellison Lafayette WWTP	Individual	VA0062219	11.2
Blacksburg Country Club – STP	Individual	VA0027481	1.57
Roanoke Moose Lodge	Individual	VA0077895	0.21
Roanoke County	MS-4	VAR040022	1823
City of Roanoke	MS	VAR040004	1487
Town of Vinton	MS	VAR040026	128
Botetourt County	MS	VAR040023	327
City of Salem	MS	VAR040010	589
VADOT Roanoke Urban Areas	MS	VAR040017	27
Virginia Western Community College	MS	VAR040030	2
Virginia Medical Center	MS	VAR040050	10
VDOT Montgomery County Urban Area	MS	VAR040016	4
Town of Blacksburg	MS	VAR040019	102
Town of Christiansburg	MS	VAR040025	72

Load Allocations

According to Federal regulations at 40 CFR 130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible, natural and nonpoint source loads should be distinguished. The GWLF model was used to ascertain the sediment loading to both the impaired and non-impaired segments of the Roanoke River. The model provides the monthly sediment load to the stream through the use of the universal soil loss equation (USLE). The USLE derives the sediment loading by using information on precipitation rates, best management practices, land slope, and vegetative cover. Table 3 identifies the current and TMDL loading for sediment to the Roanoke River.

Table 3 - LA for Sediment for Roanoke River

Source Category	Existing Load (Mg/yr)	Proposed Load (Mg/yr)	Percent Reduction
Forest and Wetland	1,023	1,023	0
Agriculture	4,557	1,390	69.5
Transitional	698.4	213.6	69.5
Developed	1,018.4	310.6	69.5
Quarries and Mines	367.2	112	69.5

3) The TMDL considers the impacts of background pollution.

The TMDL considers the impact of background pollutants by considering the sediment loadings from background sources such as forested land.

4) The TMDL considers critical environmental conditions.

According to EPA's regulation 40 CFR 130.7 (c)(1), TMDLs are required to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the Roanoke River is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[8]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The GWLF model was run over a 10-year period to insure that it accounted for a wide range of climatic conditions. The allocations developed in these TMDLs will therefore insure that the criterion is attained over a wide range of environmental conditions including wet and dry weather conditions.

5) The TMDL considers seasonal environmental variations.

Seasonal variations involve changes in stream flow and loadings as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flows normally occur in early spring from snow melt and spring rain, while seasonally low flows typically occur during the warmer summer and early fall drought periods. Consistent with the discussion regarding critical conditions, the GWLF model and TMDL analysis effectively considered seasonal environmental variations through the use of observed weather data over an extended period of time and by modifying waste application rates, crop cycles, and livestock practices.

6) The TMDL includes a margin of safety.

[8]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. The MOS may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the WLA, LA, or TMDL. An explicit 10 percent MOS was used for the sediment TMDL.

7) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the CWA, commonly referred to as the Nonpoint Source Program.

8) The TMDL has been subject to public participation.

During the development of the TMDL for the Roanoke River benthic impairment, public meetings were held to discuss and disseminate the TMDL. A basic description of the TMDL process and the agencies involved was presented at the first public meeting on October 7, 2004, in Roanoke, Virginia with 41 people in attendance. The second public meeting was held on August 4, 2005 at East Montgomery High School in Shawsville, Virginia with 11 people in attendance. A third public meeting was held in Roanoke Virginia on August 09, 2005 with 22 people in attendance. Notices for the public meetings were placed in the Virginia Register and were open for a 30-day public comment period.